

Amendment of the claims under Article 19(1)

1. (Amended) An exhaust purification device for internal combustion engine, comprising:

5 a catalytic converter provided in an exhaust passage of an internal combustion engine,

an air/fuel ratio forcibly modulating element for forcibly modulating the air/fuel ratio of exhaust flowing into the catalytic converter, between a lean air/fuel ratio leaner than a target average air/fuel ratio and a rich
10 air/fuel ratio richer than the target average air/fuel ratio, with a specific period, a specific amplitude, a specific modulation ratio and a specific waveform,

an oxygen sensor provided in the exhaust passage for detecting the oxygen concentration of the exhaust and
15 supplying an output corresponding to the detected oxygen concentration,

a time ratio calculating element for obtaining the ratio of a time for which the output of the oxygen sensor is greater than a standard value for the output set between
20 the maximum and minimum values of the output, or of a time for which the output of the oxygen sensor is smaller than the standard value for the output, in a predetermined period of time, or a value correlating with the ratio, and

an air/fuel ratio adjusting element for adjusting the
25 air/fuel ratio of the exhaust during the forcible modulation, on the basis of the ratio or the value correlating with the ratio obtained by the time ratio calculating element, wherein

the period of the modulation is set to be equal to or
30 shorter than a maximum period which ensures the air/fuel ratio to be detected on the basis of the output of the oxygen sensor does not reach the upper or lower limit of a range of air/fuel ratios detectable by the oxygen sensor.

2. The exhaust purification device for internal combustion engine according to claim 1, wherein the predetermined period of time is an integer times the period of the modulation.

5 3. (deleted)

4. The exhaust purification device for internal combustion engine according to claim 1, wherein the air/fuel ratio forcibly modulating element performs the forcible modulation so that the output of the oxygen sensor varies passing through a switch point of an output characteristic curve of the oxygen sensor.

5. The exhaust purification device for internal combustion engine according to claim 4, wherein the standard value for the output is set to an output value at the switch point or in the vicinity of the switch point.

6. The exhaust purification device for internal combustion engine according to claim 1, wherein the oxygen sensor has a catalytic function.

7. The exhaust purification device for internal combustion engine according to claim 1, wherein the air/fuel ratio adjusting element adjusts the air/fuel ratio of the exhaust during the forcible modulation, on the basis of a difference between the ratio or the value correlating with the ratio obtained by the time ratio calculating element and a standard value for the ratio.

8. The exhaust purification device for internal combustion engine according to claim 1, wherein the value correlating with the ratio is obtained, when the ratio is greater than the standard value for the ratio, by correcting the ratio in a manner such that the ratio is more increased when the period of the modulation is longer

and more decreased when the period of the modulation is shorter, and when the ratio is smaller than the standard value for the ratio, by correcting the ratio in a manner such that the ratio is more decreased when the period of the modulation is longer and more increased when the period of the modulation is shorter.

9. The exhaust purification device for internal combustion engine according to claim 1, wherein the value correlating with the ratio is obtained, when the ratio is greater than the standard value for the ratio, by correcting the ratio in a manner such that the ratio is more increased when the amplitude of the modulation is greater and more decreased when the amplitude of the modulation is smaller, and when the ratio is smaller than the standard value for the ratio, by correcting the ratio in a manner such that the ratio is more decreased when the amplitude of the modulation is greater and more increased when the amplitude of the modulation is smaller.

10. The exhaust purification device for internal combustion engine according to claim 1, wherein the value correlating with the ratio is obtained, when the ratio is greater than the standard value for the ratio, by correcting the ratio in a manner such that the ratio is more increased when the waveform of the modulation is closer to a square wave and more decreased when the waveform of the modulation is further from the square wave, and when the ratio is smaller than the standard value for the ratio, by correcting the ratio in a manner such that the ratio is more decreased when the waveform of the modulation is closer to the square wave and more increased when the waveform of the modulation is further from the square wave.

11. The exhaust purification device for internal

combustion engine according to claim 1, further comprising
a rotational speed detecting element for detecting the
rotational speed of the internal combustion engine, wherein
the value correlating with the ratio is obtained, when
5 the ratio is greater than the standard value for the ratio,
by correcting the ratio in a manner such that the ratio is
more increased when the rotational speed of the internal
combustion engine detected by the rotational speed
detecting element is higher and more decreased when the
10 rotational speed is lower, and when the ratio is smaller
than the standard value for the ratio, by correcting the
ratio in a manner such that the ratio is more decreased
when the rotational speed is higher and more increased when
the rotational speed is lower.

15 12. The exhaust purification device for internal
combustion engine according to claim 1, further comprising
an exhaust flow rate detecting element for detecting
the flow rate of the exhaust, wherein
the value correlating with the ratio is obtained, when
20 the ratio is greater than the standard value for the ratio,
by correcting the ratio in a manner such that the ratio is
more increased when the flow rate of the exhaust detected
by the exhaust flow rate detecting element is greater and
more decreased when the flow rate of the exhaust is smaller,
25 and when the ratio is smaller than the standard value for
the ratio, by correcting the ratio in a manner such that
the ratio is more decreased when the flow rate of the
exhaust is greater and more increased when the flow rate of
the exhaust is smaller.

30 13. The exhaust purification device for internal
combustion according to claim 1, wherein
the standard value for the ratio of the time for which
the output of the oxygen sensor is greater than the

standard value for the output, or for the value correlating with the ratio is in the range of 0.5 to 0.75.

14. The exhaust purification device for internal combustion according to claim 1, wherein

5 the standard value for the ratio of the time for which the output of the oxygen sensor is smaller than the standard value for the output, or for the value correlating with the ratio is in the range of 0.25 to 0.5.

15 15. The exhaust purification device for internal combustion according to claim 1, wherein

 the air/fuel ratio forcibly modulating element includes a change element for making change according to the operating states of the internal combustion engine, and the time ratio calculating element stores changed
15 periods of the modulation in the past, and obtains the value correlating with the ratio, from the time for which the output of the oxygen sensor is greater than the standard value for the output or the time for which the output of the oxygen sensor is smaller than the standard
20 value for the output, obtained this time, and a past changed period of the modulation stored.

16. The exhaust purification device for internal combustion according to claim 1, wherein

 the air/fuel ratio forcibly modulating element
25 includes a change element for making change according to the operating states of the internal combustion engine, and the time ratio calculating element stores the time for which the output of the oxygen sensor was greater than the standard value for the output or the time for which the
30 output of the oxygen sensor was smaller than the standard value for the output, obtained last time, and obtains the value correlating with the ratio, from the time for which the output of the oxygen sensor is greater than the

standard value for the output, obtained this time, and the
sum of the time for which the output of the oxygen sensor
is greater than the standard value for the output, obtained
this time, and the time for which the output of the oxygen
5 sensor was smaller than the standard value for the output,
obtained last time, or from the time for which the output
of the oxygen sensor is smaller than the standard value for
the output, obtained this time, and the sum of the time for
which the output of the oxygen sensor is smaller than the
10 standard value for the output, obtained this time, and the
time for which the output of the oxygen sensor was greater
than the standard value for the output, obtained last time.